View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by Elsevier - Publisher Connector

Taiwanese Journal of Obstetrics & Gynecology 53 (2014) 471–475

Contents lists available at ScienceDirect

Taiwanese Journal of Obstetrics & Gynecology

journal homepage: www.tjog-online.com

Original Article

Accessibility and surgical outcomes of transumbilical single-port laparoscopy using straight instruments for hysterectomy in difficult conditions

Chen-Ying Huang [a, 1], Kai-Yun Wu [a, 1], Hsuan Su [a], Chien-Min Han [a], Pei-Ju Wu [a], Chin-Jung Wang [a], Chyi-Long Lee [a], Chih-Feng Yen [a, b, *]

[a] Department of Obstetrics and Gynecology, Chang Gung Memorial Hospital at Linkou and Chang Gung University College of Medicine, Kwei-Shan, Tao-Yuan, Taiwan

[b] Graduate Institute of Clinical Medical Sciences, Chang Gung University College of Medicine, Taipei, Taiwan

ARTICLE INFO

Article history:
Accepted 5 August 2014

Keywords:
hysterectomy
laparoendoscopic single-site (LESS) surgery
single-port laparoscopy

ABSTRACT

Objectives: To evaluate the accessibility of transumbilical single-port laparoscopy for hysterectomy in difficult conditions.

Materials and methods: This prospective observational study recruited patients with benign diseases who were scheduled for laparoscopic hysterectomy between March 2010 and October 2011 to undergo the transumbilical single-port approach with straight instruments and a laparoscope.

Results: In total, 109 patients were included with a mean [± standard error of the mean (SEM)] age of 45.9 ± 0.4 years and mean body mass index of 23.9 ± 0.3 kg/m^2. The yielded mean uterine weight was 403.4 ± 25.3 g, with 28 (25.7%) weighing ≥500 g, including four specimens >1000 g, and 44 (40.4%) needed concurrent adhesiolysis. The operative time was 117.2 ± 4.2 minutes, estimated blood loss was 270.3 ± 22.9 mL, and the postoperative hospital stay was 2.8 ± 0.1 days. Patients with a uterus weighing ≥500 g had a higher intraoperative blood loss in comparison with those with a uterus weighing <500 g (375.4 ± 55.3 mL vs. 234.0 ± 23.0 mL; $p < 0.05$) and a higher incidence of blood transfusion (17.9% and 6.2%, respectively). The single-port approach was abandoned in four (3.7%) patients with severe pelvic adhesion—an additional port was opened for extensive adhesiolysis. None of the patients with a voluminous uterus needed an additional port. There were no major intraoperative or postoperative complications.

Conclusion: The single-port approach using straight, conventional laparoscopic instruments was feasible and safe in the majority of the patients undergoing hysterectomy, and was found to be accessible even in cases with a large uterus. The patients benefitted from this approach and had less abdominal wounds. However, patients with a voluminous uterus tended to have more intraoperative blood loss, and in some cases with severe adhesions, additional port(s) were required for surgical effectiveness.

Copyright © 2014, Taiwan Association of Obstetrics & Gynecology. Published by Elsevier Taiwan LLC. All rights reserved.

Introduction

Since its first publication in 1989 [1], laparoscopy has become the preferred route for hysterectomy in patients with benign disease, in those with a large uterus, or in other difficult situations [2,3]. Emerging evidence has proved that minimally invasive surgery has several advantages over open surgery, such as better surgical view due to the magnification of the video-laparoscope, less blood loss, faster recovery, shorter hospital stay, fewer wound complications, and less adhesion and scar formations [4–8].

Transumbilical single-port laparoscopic hysterectomy was first reported by Dr Pelosi with bilateral salpingo-oophorectomy in 1991 [9], but this method did not seize much attention then. Recently, because of the progress and evolution of instruments [10–12], single-port laparoscopy has resurged again [13–15]. Although it offers the benefits of better cosmetic results, single-port laparoscopy was frequently questioned regarding its feasibility in daily practice given the prominent drawbacks associated with technical

* Corresponding author. Department of Obstetrics and Gynecology, Chang Gung Memorial Hospital at Linkou, 5 Fu-Hsin Street, Kwei-Shan Tao-Yuan, Taiwan.
E-mail address: yen2158@gmail.com (C.-F. Yen).

[1] These authors contributed equally to this work.

http://dx.doi.org/10.1016/j.tjog.2014.08.002

1028-4559/Copyright © 2014, Taiwan Association of Obstetrics & Gynecology. Published by Elsevier Taiwan LLC. All rights reserved.

difficulties arising from instrument crowding, clashing, and loss of triangulation. In addition, the newly designed instruments could also increase much of the surgical costs [16]. Due to the restricted handling space, many operators drive only one instrument in single-port laparoscopy, which precludes its feasibility in dealing with difficult surgeries. However, the need for effective laparoscopic management in difficult conditions such as in the case of large uterus [3,17] or severe adhesions was frequently encountered in our daily practice. According to our experience, we hypothesized that the transumbilical single-port approach with conventional straight instruments was sufficient for dealing with the majority of difficult conditions of laparoscopic hysterectomy [18]. Therefore, we conducted a study to test its feasibility and safety, with special focus on the conditions of large uterus and severe adhesion.

Materials and methods

Patients

This study was performed by reviewing the records of patients undergoing transumbilical single-port laparoscopic hysterectomies from March 2010 to October 2011 in Chang Gung Memorial Hospital. Patients requiring hysterectomy with a preoperative diagnosis of leiomyoma, adenomyosis, or other benign diseases were included in the study. Patients with the circumstances of previous abdominal surgeries, suspect severe pelvic adhesion, large uteri, obesity, or nulliparity were also included. Patients with malignancies were excluded from the study.

This study was reviewed and approved by the Human Investigation Review Board of Chang Gung Memorial Hospital. All patients undergoing surgical management gave their written informed consents. All surgeries were performed by experienced gynecological endoscopists.

Surgical instruments

Previously published surgical techniques [19] are described in brief as the following. We used a rigid, 0-degree, 5-mm or 10-mm laparoscope (KARL STORZ GmbH & Co. KG, Tuttlingen, Germany) and conventional rigid laparoscopic instruments including scissors, a unipolar electrosurgical device, and grasper forceps. We used either Ligasure (Covidein, Valleylab, Boulder, CO, USA) or Plasma-Kinetic knife (Gyrus Medical, Maple Grove, MN, USA) [20] as energy sources in all the single-port laparoscopic procedures, and the Pelosi Uterine Manipulator (CooperSurgical, CT, USA) for uterine support.

Surgical techniques

Under general anesthesia with endotracheal intubation, patients were placed in Trendelenburg position with legs bandaged and supported in the stirrups. One 12-French Foley catheter was indwelled.

Establishment of the transumbilical port

The operation was started with a 1.5-cm vertical umbilical incision. In the majority of patients, we used a retractor-and-glove system to make the transumbilical port [21]. After the peritoneal cavity was opened layer by layer, a small Alexis wound retractor (Applied Medical Resources Corp., Rancho Santa Margarita, CA, USA) was inserted. Then a disposable surgical glove was draped around the rim of the wound retractor with three 5-mm cannulas introduced through the thumb, the middle, and the little fingers of the glove, respectively. In a few other patients, we used a single-incision laparoscopic surgery (SILS) Port (Covidien, Norwalk, CT, USA) with two 5-mm and one 12-mm cannulas inserted simultaneously through separate flexible channels. After establishing the pneumoperitoneum, the laparoscope was introduced into the abdomen to view the abdominal and pelvic cavity.

Laparoscopic hysterectomy

As in conventional laparoscopic assisted vaginal hysterectomy (LAVH), the surgery began with division of the left round ligament, and then the ipsilateral uterine tube and ovarian ligament; or, if the ovary was to be removed, the infundibulo-pelvic ligament. The broad ligament was then incised alongside the uterus downward to the level of the uterine artery; an incision was then made of the peritoneal reflection at the bladder base adjacent to the uterine margin. A similar procedure was repeated at the right side of the uterus. Then, the bladder base was mobilized downward carefully to expose the cervico-vesicle fascia at the lower margin of the cervix. Anterior colpotomy was then performed laparoscopically with the aid of pushing a damp-gauze into the anterior fornix and electro-cutting through the upper vaginal wall at the cervico-vaginal junction.

Then, with a vaginal approach, posterior colpotomy was performed as in conventional vaginal surgery. The cardino-uterosacral ligaments and uterine vessels were clamped, divided, and ligated with 0 vicryl (Ethicon Inc., Somerville, NJ) step by step. The uterus and other adnexal specimens were removed, with morcellation if needed, depending on the size of the specimen. The vaginal cuff was then closed in continuous sutures with 0 vicryl, and angles were ligated with the uterosacral ligament stump.

Finally, the whole pelvis and operation sites were irrigated thoroughly to ensure that complete hemostasis was achieved at the end of the surgery. Cystoscopy was performed to confirm that the bladder wall was intact and that there was obvious urine efflux from bilateral ureter orifices.

Closure of the umbilical wound

After removal of the Alexis wound retractor, both sides of the fascias of the abdominal rectus muscle at the umbilical wound were identified. The fascias were then closed with 2-0 vicryl (Ethicon Inc., Somerville, NJ) in continuous sutures together with the underlying peritoneum. The subcutaneous fatty tissues at the brim of the umbilical ring were repaired, whereas the navel of the umbilicus was fixed directly to the underlying fascia. Finally, the skin was repaired with continuous subcutaneous sutures using 4-0 monocryl (Ethicon Inc., Somerville, NJ).

Treatment protocol

We administered parenteral cefazolin (Cefa injection 1 gm/vial, Taiwan biotech group, Taiwan) preoperatively, and cefazolin and gentamicin (Genta-C, Gentle pharma, Taiwan) postoperatively for 24 hours as prophylactic antibiotics. Nonsteroidal anti-inflammatory drugs (NSAIDs) were also routinely prescribed for 24 hours. The Foley catheter was removed 24 hours after the operation. Patients were not discharged until the following recovery situations had been achieved, including an afebrile status for at least 24 hours, no evidence of surgical complications, good wound healing, and full recovery of gastrointestinal function with satisfactory oral intake and stool passages. Vaginal intercourse was prohibited for 2 months after the operation. Patients were appointed to return to the clinic 1 week after discharge and 6 weeks after the operation for check-up.

Data analysis

Age, body mass index (BMI), and uterine weight were considered as continuous variables and presented as mean ± standard error of the mean (SEM), whereas parity was considered a discrete variable and presented as median value and range. Data with

normal distributions were analyzed by an independent *t* test, while data without normal distributions were analyzed with the Mann–Whitney rank sum test. Statistics were performed using SPSS for Windows, release 17.0.0/2008 (IBM-SPSS Inc., Chicago, IL, USA).

Results

From March 2010 to October 2011, a total of 109 patients who had benign diseases and required total hysterectomy were enrolled. The demographic backgrounds of the patients are presented in Table 1. The mean age of our patient population was 45.9 ± 0.4 years, and BMI was 23.9 ± 0.3. The median parity was 2, however, nearly one third (29.4%) of the patients had never delivered from the vagina. In addition, almost half of the patients (49.5%) had a history of previous abdominal surgery, in which 36.7% was cesarean delivery, 8.3% was laparotomy, and 4.6% was laparoscopic surgery.

Surgery-related measurements are listed in Table 2. The size of the uterus was measured by weight in this series, and the mean uterine weight was 403.4 ± 25.3 g. Over half of the patients underwent concurrent procedures other than simple hysterectomy, including enucleation of ovarian tumors, salpingectomy, salpingo-oophorectomy, and extensive adhesiolysis (Table 2). However, the mean operative time was 117.2 ± 4.2 minutes, which was not significantly different in comparison with conventional LAVH. The mean estimated blood loss was 270.3 ± 22.9 mL, and the mean decrease in hemoglobin after the operation was −1.1 ± 0.1 g/dL. The postoperative length of stay in hospital was 2.8 ± 0.1 days.

There were 28 (25.7%) patients whose uterus weighed >500 g, and four (3.7%) patients >1000 g, with weights of 1068 g, 1170 g, 1581 g, and 1651 g, respectively. Comparisons of surgical outcomes between the groups of patients with uterine weight <500 g and ≥500 g were performed and listed in Table 3. The age, parity, and BMI were not different, but the rates of concomitant adhesiolysis were similar in both groups. The mean uterine weights in both groups were 286.9 ± 11.3 g and 740.6 ± 56.8 g, respectively. The operative time and length of hospital stay were similar in the two groups. The group with uterine weight ≥500 g had significantly more estimated blood loss (375.4 ± 55.3 mL vs. 234.0 ± 23.0 mL; $p < 0.05$) and higher incidence of intraoperative transfusion (17.9% vs. 6.2%) than the group of uterine weight <500 g; however, the mean decreased hemoglobin after operation in both groups were not different. No patient of uterine weight ≥500 g needed an additional trocar to facilitate single-port surgery.

Ten (9.2%) patients received transfusions during or after the operation; three patients had a uterine weight <500 g and the intraoperative estimated blood loss ranged from 200 mL to 450 mL; preoperative hemoglobin was <10 g/dL. Two patients (1 with uterus <500 g and 1 with uterus ≥500 g) had an intraoperative estimated blood loss ≥1500 mL because of the need for extensive adhesiolysis and had prolonged operative times (258 minutes and 262 minutes, respectively). Three of the four patients (75%) with uterus >1000 g had an intraoperative estimated blood loss ≥500 mL and needed transfusion.

Table 1
Patient characteristics ($N = 109$).

Age (y)	45.9 ± 0.4
Parity, median (range)	2 (0–4)
Without vaginal delivery, *n* (%)	32 (29.4%)
Body mass index (kg/m^2)	23.9 ± 0.3
Previous abdominal surgery	54 (49.5%)
Cesarean delivery only	40 (36.7%)
Laparotomy	9 (8.3%)
Laparoscopy	5 (4.6%)

Data are presented as mean ± standard error of the mean (SEM), or *n* (%), if not otherwise specified.

Table 2
Surgical outcomes ($N = 109$).

Operative time (min)	117.2 ± 4.2
Estimated blood loss (mL)	270.3 ± 22.9
Decrease of hemoglobin (g/dL)	−1.1 ± 0.1
Blood transfusion	10 (9.2%)
Uterine weight (g)	403.4 ± 25.3
≥500 g	28 (25.7%)
Ancillary port	4 (3.7%)
Hospital stay (d)	2.8 ± 0.1
Concomitant surgeries	
Enucleation	7 (6.4%)
Salpingectomy	10 (9.2%)
Salpingo-oophorectomy	7 (6.4%)
Extensive adhesiolysis	44 (40.4%)

Data are presented as mean ± standard error of the mean (SEM) or *n* (%).

Forty-four (40.4%) patients in the current series needed extensive adhesiolysis, most of which were successfully achieved with the single-port approach. However, in four (3.7%) patients needing aggressive adhesiolysis because of repeated previous surgeries or severe endometriosis, the single-port approach was abandoned and a 5-mm port was added at the left lower quadrant of the abdomen, as listed in Table 4. One of the patients (Patient 3) had a muscular bladder tear during the adhesiolysis that needed suture repair. The uterine size of the four patients was <500 g (range 150–488 g). The operative times (range 148–210 minutes) were obviously prolonged compared to the other patients ($p < 0.05$, Mann–Whitney *U* test). The intraoperative estimated blood loss ranged from 100 mL to 600 mL; however, none of these four patients needed transfusion. The mean postoperative length of hospital stay was 3 days.

No other intraoperative or postoperative complications occurred in our series. The postoperative fibril status of patients, if any, was noted to be temporary and confined within 1 day. No evidence of pelvic infection, hematoma, abscess formation, or umbilical hernia was noted in any patient. At follow-up at 1 week after discharge and 6 weeks after the operation, all patients showed good healing of the vaginal cuff and had returned to daily activities uneventfully.

Discussion

One of the characteristics of the current study was that we did not set exclusion criteria to undergo single-port laparoscopy (other than malignancy) for patients needing hysterectomy, and we included many patients who were considered as difficult situations for conventional laparoscopy. Another characteristic was that we did not use curved or articulated instruments or laparoscopes because the cost that was additional to the health insurance

Table 3
Comparisons of surgical outcomes between uterine weights <500 g and ≥500 g.

	<500 g ($n = 81$)	≥500 g ($n = 28$)
Age (y)	45.6 ± 0.5	46.9 ± 0.6
Parity, median (range)	2 (0–4)	2 (1–4)
Without vaginal delivery, *n* (%)	26 (32.1%)	6 (21.4%)
Body mass index (kg/m^2)	23.8 ± 0.4	24.1 ± 0.7
Concomitant adhesiolysis	31 (38.3%)	13 (46.4%)
Uterine weight (g)	286.9 ± 11.3*	740.6 ± 56.8*
Operative time (min)	114.1 ± 4.8	126.0 ± 7.7
Estimated blood loss (mL)	234.0 ± 23.0*	375.4 ± 55.3*
Intraoperative transfusion	5 (6.2%)	5 (17.9%)
Decrease of hemoglobin (g/dL)	−1.1 ± 0.1	−1.2 ± 0.2
Ancillary port	4 (4.9%)	0
Hospital stay (d)	2.8 ± 0.1	2.6 ± 0.1

Data are presented as mean ± standard error of the mean (SEM) or *n* (%).
* Significant.

Table 4
Patients needing an additional port ($n = 4$).

	Parity	BMI	Operation history	Causes	Operation method	Operative time (min)	Blood loss (mL)	Uterine weight (g)	Pathology	Length of hospital stay (d)
1	1	19.2	Open myomectomy, laparoscopic LSO	Dense adhesion at bowels, uterus, and right adnexa	LH + RSO	148	100	150	Adenomyosis, leiomyoma, endometriosis, mucinous cystadenoma	3
2	0	31.1	Ectopic s/p open salpingectomy × 2	Omental and uterine adhesion to abdominal wall	LH	207	250	488	Adenomyosis, leiomyoma	3
3	4	22.0	C/S × 4 (longitudinal abdominal incision)	Muscular tear of urinary bladder	LH	210	200	350	Leiomyoma	4
4	2	27.9	C/S × 2 (Pfannenstiel incision)	Dense adhesion at urinary bladder	LH + enucleation of bilateral endometrioma	205	600	445	Leiomyoma, endometriosis	3

BMI = body mass index; C/S = cesarean section; LH = laparoscopic hysterectomy; LSO = left salpingo-oophorectomy; RSO = right salpingo-oophorectomy; s/p = status post.

payment was a concern; instead we completed all of the procedures with the straight instruments as used in conventional laparoscopy. As a result, in the current series, using almost the same setting as the conventional LAVH and successfully completing the single-port approach in 96.3% of the patients without complications, our experiences illustrated the accessibility and safety of the transumbilical single-port laparoscopy in performing hysterectomy.

Single-port surgery indeed increased surgical difficulty because of instrument crowding, loss of triangulation, and inline vision [2]. Some doctors found that they can handle only one instrument through the umbilical port in addition to the laparoscope. We had the same problem at the beginning; however, after the experience of the first few cases, we can now handle two conventional instruments simultaneously through the umbilical port without problem. In our experience, because we had the ability to perform a concurrent two-hand operation through the transumbilical port, we began to believe the accessibility of single-port laparoscopy, and had the confidence to shift all patients scheduled for hysterectomy to the single-port approach. Therefore, in the current series, we did not exclude patients such as those with previous abdominal surgeries, severe pelvic adhesion, large uteri, obesity, or nulliparity, which were all considered as difficult situations even for conventional laparoscopy. However, the operative time was not significantly prolonged in the current series compared with the conventional results of LAVH [22].

In our experience, gynecologists trying to perform single-port laparoscopy should have good techniques and experience in managing conventional multi-port laparoscopy, so as to shorten the learning curve and overcome the technical difficulties. We believed that having processed over 99% of the hysterectomies in our group with conventional laparoscopy for decades, the progression to single-port access was not a big leap for us so that all the single-port laparoscopic hysterectomies in the current series could be smoothly performed. In addition, we also found that hysterectomy is a suitable candidate for the start of single-port laparoscopy because hysterectomy only comprises the procedures of uterine traction, coagulation, and cutting. Advanced techniques such as retroperitoneal dissecting and suturing were rarely needed for laparoscopic hysterectomy.

In the current series, we included 28 (25.7%) patients of uterine size >500 g, and even four patients >1000 g, up to an extreme uterine size of 1651 g. However, their operative time, range of decrease of hemoglobin, and postoperative length of hospital stay were not significantly different from those with uterine size <500 g (Table 3). In the current series, it was not necessary to abandon the single-port approach in patients with a uterine weight >500 g. Therefore, technically the size of the uterus did not seem to hamper the single-port approach of laparoscopic hysterectomy. However, the patients with uterus >500 g had higher estimated intraoperative blood loss; of note, 75% of the patients with uterus >1000 g had a blood loss of >500 mL. Although the patient number was not large enough to offer any evidence, we found that this blood loss resulted from morcellation and the flow-out of old blood that had accumulated in the large uterus. We found that severe pelvic adhesion would be a more challenging condition to deal with in a single-port laparoscopy than that with a voluminous uterus. Although over 90% of the patients with pelvic adhesions were also successfully managed with single-port laparoscopy in the current series, the single-port approach had to be abandoned in four patients and an additional port was enabled for assistance—these patients had extensive and dense adhesions because of repeated previous surgeries or severe endometriosis, which undoubtedly were difficult to handle even with conventional laparoscopy. The purpose of the additional port was to reduce instrument clashing and increase the steadiness of handling, hence improving the maneuverability in a delicate surgery. Although the uterine sizes of these four patients were all <500 g (range 150–488 g), the operative time was significantly prolonged compared to other cases with the purely single-port approach. By contrast, patients with uterine size >500 g did not have prolonged operative times. None of the four patients needed transfusion. Given that the single-port laparoscopy was undeniably more difficult technically, the addition of a second port for assistance in tough situations helped to improve the procedural quality, patient safety, and also the surgical efficiency.

In a study using the same approach to surgical porting as ours, surgical outcomes including operative time, blood loss, uterine weight, and length of hospital stay were similar, but there were three cases of failure among 24 patients [23]. However, even with the using of an additional port, it is still worthy that the surgery was achieved in a minimally invasive way, and the patients had less abdominal wounds than with conventional laparoscopy and avoided laparotomy. Because all the laparoscopies in our series were performed by experienced endoscopists, we believed that the incidence of the addition of another port could be decreased as the level of a surgeon's experience increased.

We found several strategies to reduce the technical challenges of single-port laparoscopy. First, we believe that a good assistant plays an important role. A good surgical assistant knows how to handle the laparoscope to avoid instrument crashing, especially at the moment of delicate hemostasis and suturing. Second, a good uterine manipulator is crucial in single-port laparoscopic hysterectomy. A good manipulator provides proper traction of the uterus to expose a better surgical field during the operation—this can substitute for the use of additional instruments in conventional laparoscopy, especially during hysterectomy. Third, an efficient

energy system offers great benefits. As the operation field becomes restricted and the handling of instruments becomes more difficult, an electrosurgical system that offers a shorter working time and a highly reliable tissue sealing ability is indispensable; if not, a hemorrhage needing prompt hemostasis during a single-port laparoscopy can evolve into a tense and strained situation. In addition, the hand pieces used in modern energy systems, such as Ligasure or PlasmaKinetic knife, have a cutting blade accompanied with the electrode, which eliminates the time required for changing instruments, making the operation more efficient.

In conclusion, in the hands of experienced laparoscopists, the single-port approach using straight, conventional laparoscopic instruments is feasible and safe in the majority of patients scheduled for laparoscopic hysterectomy. This technique in our series was found accessible to even the large uterus without significantly prolonging the operative time, and the management of most pelvic adhesions was possible. Patients with large uterus, especially those with uterus >1000 g, tended to have more intraoperative blood loss and needed blood transfusion. In a few cases of severe pelvic adhesion, an additional port(s) was required at sites other than the umbilical region to facilitate sustaining surgical quality; however, even in the multi-port approach, the surgery was still performed in a minimally invasive fashion, and consequently we maintained better patient satisfaction. Therefore, the single-port approach for patients with benign diseases requiring hysterectomies is a good option, and is beneficial to patients as a result of less abdominal wounds.

Conflicts of interest

The authors have no conflicts of interest relevant to this article.

Acknowledgments

This study was supported by Chang Gung Memorial Hospital research grants CMRPG370151 and the National Science Council of Taiwan grants NMRPG496032 (99-2314-B-182A-048-MY2) to Dr C.F. Yen.

References

[1] Reich H. Laparoscopic hysterectomy. J Gynecol Surg 1989;5:213–6.
[2] ACOG Committee Opinion No. 444: choosing the route of hysterectomy for benign disease. Obstet Gynecol 2009;114:1156–8.
[3] Wu KY, Lertvikool S, Huang KG, Su H, Yen CF, Lee CL. Laparoscopic hysterectomies for large uteri. Taiwan J Obstet Gynecol 2011;50:411–4.
[4] Kovac SR. Hysterectomy outcomes in patients with similar indications. Obstet Gynecol 2000;95:787–93.
[5] ACOG Committee Opinion. Number 311, April 2005. Appropriate use of laparoscopically assisted vaginal hysterectomy. Obstet Gynecol 2005;105:929–30.
[6] Nieboer TE, Johnson N, Lethaby A, Tavender E, Curr E, Garry R, et al. Surgical approach to hysterectomy for benign gynaecological disease. Cochrane Database Syst Rev 2009:CD003677.
[7] Pitkin RM, Parker WH. Operative laparoscopy: a second look after 18 years. Obstet Gynecol 2010;115:890–1.
[8] Wu MP, Lee CL. The trends of minimally invasive surgery for benign gynecologic lesions, 1997–2007 in Taiwan. Gynecol Minim Invasive Ther 2012;1:3–8.
[9] Pelosi MA, Pelosi 3rd MA. Laparoscopic hysterectomy with bilateral salpingo-oophorectomy using a single umbilical puncture. N J Med 1991;88:721–6.
[10] Rosati M, Bosev D, Thiella R, Capobianco F, Bracale U, Azioni G. Single port laparoscopically assisted hysterectomy with the TriPort system. A case report and review of the literature. Ann Ital Chir 2010;81:221–5.
[11] Song T, Kim TJ, Kang HJ, Choi CH, Lee JW, Bae DS, et al. Single-port access laparoscopic surgery using a novel laparoscopic port (Octo-Port). Taiwan J Obstet Gynecol 2011;50:436–40.
[12] Chern BSM, Lakhotia S, Khoo CK, Siow AYM. Single incision laparoscopic surgery in gynecology: Evolution, current trends, and future perspectives. Gynecol Minim Invasive Ther 2012;1:9–18. http://www.e-gmit.com/article/S2213-3070(12)00006-8.
[13] Koo YJ, Im KS, Jung HJ, Kwon YS. Mature cystic teratoma of the uterosacral ligament successfully treated with laparoendoscopic single-site surgery. Taiwan J Obstet Gynecol 2012;51:86–8.
[14] Tsai HW, Chen CY, Wang PH, Yang MJ, Twu NF, Yen MS, et al. Single-port laparoscopic ovarian cystectomy of teratoma during pregnancy. Gynecol Minim Invasive Ther 2013;2:137–9.
[15] Su H, Wu KY, Kuo HH, Han CM, Lee CL, Yen CF. Transumbilical single-site laparoscopy takes the advantage of ultraminilaparotomy in managing an extremely large ovarian cyst. Gynecol Minim Invasive Ther 2012;1:37–9.
[16] Wang PH, Horng HC, Chen YJ. Is it possible to use laparoscopy to perform a cystectomy for large ovarian cysts? Gynecol Minim Invasive Ther 2013;2:1–2. http://www.e-gmit.com/article/S2213-3070(12)00040-8/fulltext.
[17] Wong WS, Lim DCE. Factors influencing the choice of hysterectomy approach for the management of fibroid uterus. Gynecol Minim Invasive Ther 2013;2:61–4. http://www.e-gmit.com/article/S2213-3070(13)00026-9.
[18] Torng PL, Lin KH, Hwang JS, Liu HS, Chen IH, Chen CL, et al. Learning curve for laparoendoscopic single-site surgery for an experienced laparoscopic surgeon. Gynecol Minim Invasive Ther 2013;2:126–31.
[19] Han CM, Wu KY, Su H, Huang CY, Wu PJ, Wang CJ, et al. Feasibility of Transumbilical Single-Port Laparoscopic Hysterectomy using Conventional Instruments. Gynecol Minim Invasive Ther 2014;3:47–9.
[20] Su H, Han CM, Wang CJ, Lee CL, Soong YK. Comparison of the efficacy of the pulsed bipolar system and conventional electrosurgery in laparoscopic myomectomy – a retrospective matched control study. Taiwan J Obstet Gynecol 2011;50:25–8.
[21] Kim TJ, Lee YY, Kim MJ, Kim CJ, Kang H, Choi CH, et al. Single port access laparoscopic adnexal surgery. J Minim Invasive Gynecol 2009;16:612–5.
[22] Corson SL. Operative laparoscopy revisited. J Minim Invasive Gynecol 2010;17:405–6.
[23] Lee YY, Kim TJ, Kim CJ, Kang H, Choi CH, Lee JW, et al. Single-port access laparoscopic-assisted vaginal hysterectomy: a novel method with a wound retractor and a glove. J Minim Invasive Gynecol 2009;16:450–3.